Bringing up the vegetation red-edge reflectivity is a good point for discussion.

"However, I do have a request. One question was already raised in the quick review of the initial submission, and this point wasn't addressed properly. In my view, Rayleigh scattering cannot be the cause for the wavelength-dependence of the "PDF" averaged over the globe (line 331 of the manuscript). Rayleigh scattering causes a smoothing of the image, in the sense that some radiation from outside the shadow is scattered into the shadow region. But i don't see why this should reduce the loss. Certainly, the shadow itself is brighter, but outside the shadow it's darker and in first approximation the integrated reflectance would be the same.

In terms of conservation of photons, this is certainly correct

Also, if Rayleigh scattering was the cause, I would have expected a wavelength dependence at the lower wavelengths, not just at the 4 higher ones. Between 317 and 551nm the Rayleigh scattering cross section varies by a factor of 10 (4th power of the wavelength) - yet all reduction values are the same.

After rethinking the problem for the global integral, the percent change in the UV should be almost independent of wavelength. Rayleigh scattering is essentially a smooth fog with strong wavelength dependence..

Between 680 and 780nm, Rayleigh varies much less, yet the reflectance changes from 10 to 13%. As suggested before, this has probably nothing to do with Rayleigh scattering but with the vegetation edge. The stronger attenuation starts exactly at the wavelengths were the vegetation reflectance starts increasing, and since the shadow is over land, the longer wavelengths are attenuated disproportionally since the shaded area is much brighter than the ocean and hence a shadow causes larger reduction compared to lower wavelengths where the land is equally dark as the ocean. Could you please consider that, or convince me that I am wrong?"

If I understand your argument, it is that more light is reflected from land vegetation for wavelengths longer than about 700 nm. Some of the vegetation reflected light is scattered from land onto ocean surfaces where it is absorbed (low reflectivity). This would cause a larger reduction from the eclipse than at shorter wavelengths where the land reflectivity is low.

I'm not sure that I agree with this argument. The same type of reflection and scattering occurs on non-eclipse days as occurs on eclipse days. The fractional change caused by the eclipse is just proportional to Fo*d, where d is the fractional obscuration. However, there is another effect. Light scatters from brighter regions to dimmer regions reducing the percent change caused by the eclipse. Except within the region of totality, this effect is very small. This is opposite of the numbers in Table 3. Plus, the O2 A-band (13%) shows a larger number than 780 nm (12%).

When observing this eclipse from Casper, the overhead sky was mostly dark with a ring of whitish light near the horizon. This horizon light caused the percentage change in illumination to decrease at the center of totality. The horizontal view is limited to no more 56 km by the earth's curvature. The light band was about 5 degrees of elevation above the horizon, which means it covered much greater distances. The white light reaching me was caused by atmospheric scattering in the visible range. A similar effect must occur at 780 nm, except that the Rayleigh scattering from bright regions into darker regions is smaller. If there are clouds in the brighter region, then some light will be scattered into the darker region decreasing the percent change. Light scattering from high reflectivity regions (land) to low reflectivity regions (oceans) will be lost, but in the same proportion as on non-eclipse days. I think that it is likely that there is insufficient data to explain the wavelength dependence. This is where your 3-D model could be a big help.

I have revised (green) the paragraph to read

Percent difference PDF(λ_i) calculations for λ_i = 317.5, 325, 340, 388, 443, 551, 680, 688, 764, and 780 nm, based on Eqn. 1 are summarized in Table 3A, yielding PDF($\lambda_{\mathbf{i}}$) = 9, 9, 9, 9, 9, 9, 10, 10, 13, and 12 % reductions in backscattered radiances in the direction of L_1, respectively for Casper with similar values for Columbia. The PDF(764 nm) within the strongly absorbing O_2 A-band is 13 % for Casper and 14% for Columbia, even though the reflected ICs(764nm) is much lower than the surrounding non-absorbed bands. The fact that adjacent absorbed and non-absorbed wavelengths give consistent PDF($\lambda_{\mathbf{i}}$) suggests that most of the effect comes from clouds. Eclipse effects for the short UV wavelengths are affected by Rayleigh scattering and clouds, and not much by the relatively low UV surface reflectivity (about 4%). Eclipse effects on outgoing radiances for wavelengths longer than about 700 nm are increased by vegetation reflectivity, even where the amount of clear-sky penetrating radiances are small for the O2 688 and 764 nm channels. There is insufficient information to explain the small observed wavelength dependence in Table 3.